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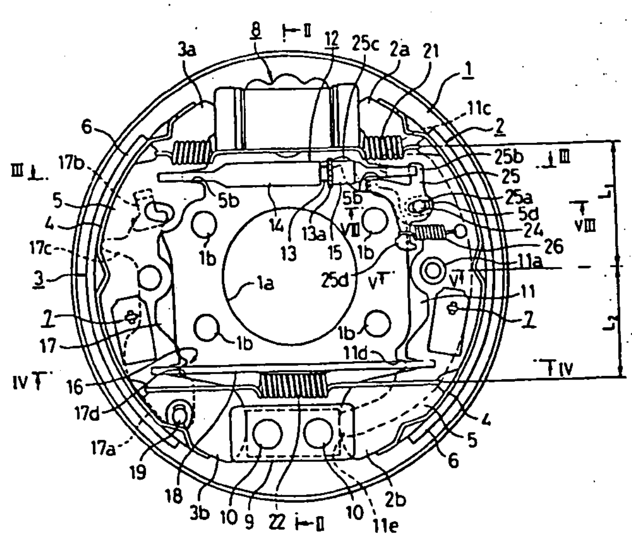
(54) Drum brake device

(57) A drum brake device is provided comprising a first and second brake shoes (2,3) disposed on a back plate (1). One set of adjacent ends (2a,3a) of the brake shoes engage a brake actuator (8). The other adjacent ends (2b,3b) engage a fixed anchor block (9). An idler link (11) is pivotally mounted on one of the brake shoes (2,3), which engages at one end with a shoe clearance adjustment device (12) and at its other end with a parking brake actuator (18). The idler link (11) moves in tandem with the first brake shoe (2) when the service brake is applied.

Fig. 1



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Description

The present invention relates to a drum brake, more specifically to a drum brake which functions as a leading-trailing (LT) type when the service brake is applied and as a duo-servo (DS) type when the parking brake is applied.

A drum brake of this type is disclosed in Australian patent number AU-B1-53 491/79, and in the U-S. patent number US-A-5,275,260. The basic function of these devices is the same and will be explained with reference to Fig. 15.

A pair of brake shoes b, c are arranged on a back plate a. The respective adjacent lower ends of each brake shoe engages an anchor block d while two coil springs e, f urge the adjacent ends in the direction toward the anchor block d. A hydraulic cylinder g is disposed between and engaged the ends of the respective brake shoes b, c for applying a hydraulic pressure. A return spring h provides a force urging the two brake shoes in the direction toward one another.

The prior art of Fig. 15 also includes a parking lever j pivoted at one end i of the brake shoe b. When pivoted in the clockwise direction, the lever j urges the first connector rod l into engagement with the idler lever k. The idler lever k is mounted to pivot on the brake shoe c. The second connector rod m engages both the other end of the idler lever k and the brake shoe c. The second connector rod m also engages with the brake shoe b.

The operation of the brake is explained as follows. When the driver steps on the brake pedal, the hydraulic cylinder g is pressurized. The two brake shoes b, c spread open while being abutted to the anchor block d as the fulcrum, thereby frictionally engaging the rotating brake drum (not shown) in a leading-trailing braking action.

When the parking brake is applied, the braking lever j is urged in the direction of the arrow X. The force of this action is transferred in sequence to the first connector rod l, the idler lever k, the second connector rod m and the one brake shoe b. The brake shoe opens about its point of abutment with the anchor block d and frictionally engages the brake drum. At the same time, the idler lever is urged outwardly being abutted against the second connector rod m as the fulcrum. The lever k urges the other brake shoe c outwardly at its pivot point in the direction of the arrow Y to frictionally engage the brake drum. Additionally, a reactive force of the parking lever j arises in the direction of the arrow Z at the end i of the one brake shoe b.

If at this time, the brake drum is rotating in the direction of the arrow R, the frictional force on the one brake shoe b is transferred to the second connector rod m. The other end q of the rod presses against the other brake shoe c, which is supported by the anchor block d, giving rise to the duo-servo braking action. If the brake drum rotates in the direction opposite the arrow R, the frictional force on the other brake shoe c is transferred to the second connector rod m. The other end p of the rod is then pressed against the one brake shoe b, which is supported by the anchor block d, resulting in the same duo-servo braking action as above.

As is evident from this parking brake operation, when the other end q of the second connector rod m abuts the idler lever k and a gap arises between the other end q and the other brake shoe c, then the piston of the hydraulic cylinder g extends by an amount equivalent to the gap. This is the case when the brake drum rotates in the opposite direction of the arrow R. As a result, the, brake pedal retracts which is not only disconcerting to the driver but also the pedal stroke increases for the next brake application. Conversely, if the other end q of the second connector rod m abuts against the other brake shoe c and a gap exists between the other end q and the lever k, then the stroke of the parking brake lever j increases by an amount equivalent to this gap. This causes the stroke required in operating the hand brake lever to increase. It would clearly be preferable that the gap between the upper end q of the second connector rod m with either the other brake shoe c or the lever k be as small as possible.

Fig. 16 illustrates an automatic shoe clearance device as disclosed in US-A-5,275,260. The base end y of an adjustment lever r is pivotally mounted on the web of the brake shoe c, while an upper arm s is engaged in a groove of an upper strut t. Another arm engages a star wheel u on said upper strut t. A spring w mounted between the adjustment lever r and an idler lever v urges the adjustment lever r in the counter-clockwise direction with the base end y as the fulcrum. When the brake linings become worn causing the two brake shoes b, c to open more than a prescribed value, the other arm causes the star wheel u to rotate. This rotation automatically increases the entire length of the upper strut t thereby maintaining a constant clearance between the brake shoes b, c and the brake drum z.

The device described above has the following points that need to be improved.

1. When the idler lever k is pivoted to rotate on the other brake shoe c, it is very difficult to always maintain proper alignment of the components.

2. When the parking brake j is applied, the two brake shoes, at both the upper and lower ends, move apart. The upper ends p, q can move away from the hydraulic cylinder g, while the lower ends move away from the anchor block d. If the parking brake is applied, when the wheels are in slight rotation, the brake drum will lock with the spread apart brake shoes b, c, and the entire mechanism will rotate in tandem until one or the other brake shoe contacts the anchor block d. This will have the effect that one of the brake shoes will collide against the anchor block producing a noise which is disconcerting to the driver. In addition, since the impact load of the brake shoe against the anchor block may diminish the structural strength of the components, stronger but heavier materials are used

in the conventional brakes.

3. The adjacent ends of the brake shoes b, c of the conventional brakes, when the brake lever j is not set in its return position precisely, will be separated from the anchor block d even if the brake is not operated. Therefore, the brake shoes may slightly but undesirably move in the drum upon the operation of the vehicle. The movement may cause unusual dragging between the lining and the brake drum and/or may have the brake shoe to bite the brake resulting in the wheel being locked.

4. In the conventional device such as AU-B1-53 491/79 an undesirable effect is the play generated when pressure is applied to the service brake by actuating the cylinder g. The upper adjacent ends p, q of the brake shoes move apart. At this time, the idler lever k and the connector rods l, m can vibrate when the vehicle is in motion and create a disturbing noise. This noise can also be disconcerting to the driver of the motor vehicle.

5. As the lining of the brake shoe c gradually wears, there is a gradual shift in the point at which the second connector rod m engages with the brake shoe c or the lever k. This is shown in Fig. 15, where the amount of displacement δ of the brake shoe c at the pivot point of the brake shoe c and idler lever k and the amount of displacement δc and δk of the brake shoe c and the idler lever k from the paint of engagement with the second connector m is defined as follows:

Formula (1)

$$\text{Brake shoe displacement } \delta\,c = \frac{H1 + H2}{H1} \times \delta$$

Formula (2)

$$\text{Idler lever k displacement } \delta\,k = \frac{H2 + H3}{H3} \times \delta, \text{ where}$$

H1: Distance from anchor d to the brake center (pivot point of brake shoe c and idler lever k)
H2 Distance from the brake center to the second connector rod m
H3: Distance from the brake center to the first connector rod l
δ : Amount of lining wear at the pivot of the brake shoe c and idler lever k

In the present case, H3 is considerably smaller than H1, so that the displacement δ k of the lever k will be considerably larger than the displacement δ c of the brake shoe c. Thus for the conventional device of US-A-5,275,260, as the lining wears, the adjustment lever r becomes engaged with the brake shoe c and moves about the support block as the fulcrum, while the pivot lever moves about the lower strut as its fulcrum. This changes the biasing force of the adjustment spring w which urges the adjustment lever r. A negative effect results on the automatic adjustment process when only a very small adjustment is required.

It is therefore an object of the present invention to avoid the above-mentioned drawbacks by providing a stable leading-trailing type service brake combined with a highly effective duo-servo type parking brake having an automatic shoe clearance mechanism which functions accurately over a prolonged period of time, in which no disconcerting noises are generated, in which no undesirable impact loads are applied to the brake components thus also enabling a lighter device, and in which the drum brake prevents unusual dragging occurring between the lining and the brake drum and/or prevents the brake shoe biting the brake drum resulting in the wheel being locked.

According to the present invention, a drum brake device is provided as defined in Claim 1. First and second brake shoes are disposed opposite one another on a back plate so as to be engageable with a brake drum. A service brake actuator is disposed between a first pair of adjacent ends of the brake shoes. An anchor block is disposed between a second pair of adjacent ends of the brake shoes. A shoe clearance adjustment device is arranged adjacent to the service brake actuator and disposed between the brake shoes. Parking brake actuator means are disposed adjacent to the anchor block. An idler link is pivotally mounted at a central region of the first brake shoe. The first end and the second end of the link functionally engage with the shoe clearance adjustment device and the parking brake actuator means, respectively. An adjustment mechanism is provided to move the link together with the first brake shoe when the service brake actuator is operated.

Preferably, the second end of the link is urged to engage with the anchor block. In a further embodiment, a torque

is imparted to the link in the same direction in which the first brake shoe spreads open, the torque being applied about the pivot component in the central region of the link as the fulcrum. The mechanism to regulate the rotation is arranged between the link and the first brake shoe.

Preferably, the shoe clearance adjustment device is adapted to sense the amount by which the pair of brake shoes have opened and automatically adjust the clearance between the brake shoes and the brake drum.

Preferably, shoe return springs are provided to urge the brake shoes toward one another. The force urging the second adjacent ends of the brake shoes toward one another is greater than the force urging the first adjacent ends of the brake shoes toward one another. In a further embodiment, the amount of the torque applied to the second adjacent ends of the brake shoes which is adjusted by arranging the force of the second shoe return spring and the distance from the pivotal mount of the brake shoe to the second return spring is greater than the torque applied to the first adjacent ends of the brake shoes which is adjusted by arranging the force of the first shoe return spring and the distance from the pivotal mount of the brake shoe to the first return spring.

Preferably, a protuberance is integrally formed by a press onto the central region of the idler link and the protuberance is pivotable in a hole bored in the first brake shoe.

The present invention as described above provides the following advantages.

By regulating the direction in which the long link can rotate with respect to the brake shoes, its engagement point with the shoe clearance adjustment device can be easily checked by visual inspection when assembling the link and the brake shoe.

The adjustment spring and other components of the automatic adjustment mechanism for the automatic shoe clearance adjustment device all move in tandem with the brake shoes. This ensures a constant clearance between the brake drum and the brake shoes, even with increased wear of the linings.

The ends of the brake shoes on the anchor block side can be prevented from opening solely and easily by a proper setting of the mounting load of the shoe return springs and their positions.

The drum brake device of the present invention ensures that the brake shoes do not separate from the anchor block even when the parking brake is applied. Consequently, no noise is generated and the discomfort or anxiety of the driver is eliminated. This applies as well when a torque is generated on the brake shoes by the brake drum. Moreover, the undesirable impact of the brake shoes against the anchor plate can be avoided, which allows the material strength of the components to be lessened, making the device on the whole lighter.

The adjacent ends will not be separated from the anchor block even in the situation that the brake lever is not set in its return position precisely, thereby preventing unusual dragging occurring between the lining and brake drum and/or preventing the brake shoe biting the brake-drum resulting in the wheel being locked.

The invention is also applicable to other component configurations. For example, an incremental or one-shot type automatic shoe clearance adjustment device can be used. In addition, a forward pull or across-pull type parking brake device can be utilized. Further objects and advantages of the present invention will become apparent in the following discussion of embodiments in conjunction with the drawings, in which:

Fig. 1 is a plan view of a brake drum device according to one embodiment of the invention;

Fig. 2 is a cross-sectional view of the embodiment of Fig. 1 taken along the line II-II;

Fig. 3 is a cross-sectional view of the embodiment of Fig. 1 taken along the line III-III;

Fig. 4 is a cross-sectional view of the embodiment of Fig. 1 taken along the line IV-IV;

Fig. 5 is a cross-sectional view of the embodiment of Fig. 1 taken along the line V-V;

Fig. 6 illustrates a modified arrangement of the pivotal mounting of the idler lever to the brake shoe;

Fig. 7 is a plan view of a drum device according to another embodiment of the present invention;

Fig. 8 is a cross-sectional view of the embodiment of Fig. 1 taken along the line VIII-VIII;

Fig. 9 is a plan view of a brake drum device according to a further embodiment of the present invention;

Fig. 10 is a cross-sectional view of the embodiment of Fig. 9 taken along the line X-X;

Fig. 11 is a plan view of a drum brake device according to a further embodiment of the present invention;

Fig. 12 is a plan view of a still further embodiment of the present invention;

Fig. 13 is a cross-sectional view of the embodiment of Fig. 12 taken along the line XIII-XIII;

Fig. 14 is a cross-sectional view of the embodiment of Fig. 12 taken along the line XIV-XIV;

Fig. 15 is a plan view of a conventional drum brake device as disclosed in Australian patent number AU-B1-53 491/79;

Fig. 16 is a plan view of a conventional drum brake device as disclosed in US-A-5,275,260;

A first embodiment of the present invention will be explained in conjunction with Figs. 1 to 6. Fig. 1 illustrates a back plate 1 having a central hole 1a freely mountable on a vehicle axle. The back plate 1 is secured to a stationary part of the vehicle by four bolts inserted through the bolt holes 1b. Two brake shoes 2, 3 are disposed opposite one another, each configured as a shoe rim 4 and a shoe web 5 joined to form a T in cross-section. A lining 6 is affixed around the outer surface of each shoe rim 4. Braking force is created by urging the linings against a brake drum (not shown in the figure). Each brake shoe is mounted on the back plate 1 by a holding mechanism 7 as shown in Fig. 2, which includes a plate spring and pin as is known per se.

A service brake actuator 8 is disposed between a first pair of adjacent ends 2a, 3a of the brake shoes. The actuator 8 is secured to the back plate 1 with bolts or other securement means. The service brake actuator 8 comprises a hydraulic wheel cylinder known in the art, however which may also be an air wheel cylinder.

The anchor block 9 is disposed between the second pair of adjacent ends 2b, 3b of the brake shoes 2, 3. The anchor block 9 is secured to a raised portion of the back plate 1 by rivets 10 shown in Fig. 2. The anchor block 9 can alternatively be welded to the back plate 1. Moreover, an anchor pin can be used in place of the rectangular plate shown in Figs. 1 and 2. In either case, the anchor must be adapted to support and engage each of the second adjacent ends 2b, 3b of the brake shoes 2, 3.

An elongated idler link 11 is pivotally mounted to the shoe web 5 of the first brake shoe 2 in an overlapping manner as seen in Fig. 1. As seen in Fig. 5, the idler link 11 comprises a protuberance 11a which is formed as a burr with a press. The protuberance 11a is formed in a central region of the link 11 and passes into a hole 5a provided in the shoe web 5. The arrangement provides a pivotal connection.

The link 11 comprises first and second ends having notched grooves 11c, 11d formed therein in Fig. 1. The lower segment of the link 11 extends from the notched groove 11d and comprises an end face 11e arranged to abut against the anchor block 9.

Fig. 5 illustrates the configuration of the protuberance 11a, while Fig. 6 shows an alternative means for the pivotal mounting employing a protuberance 11b formed as drawing with a press. Alternatively, a protuberance can be formed on the shoe web in a hole formed in the link 11 or a separate pin can be used for the pivotal mounting of the idler link 11.

A shoe clearance adjustment device 12 allows adjustment of the clearance of the brake drum (not shown) and the lining 6 of the respective brake shoe 2, 3. The adjustment device shown in Figs. 1 and 3 can allow automatic clearance adjustment, to be described later. For manual adjustment, a screwdriver can be inserted into a hole lc provided in the back plate 1 or in the brake drum. By this means, the toothed adjustment wheel 13a shown in Figs. 1 and 3 can be turned. The wheel 13a is integrally molded with the bolt 13. By rotation of the adjustment wheel 13a into or out of the tube segment 14, the length of the adjustment device 12 can be set.

As best seen in Fig. 3, a socket 15 supports one end of the bolt 13. Either end of the adjustment device is provided with a plate extending in the direction of the respective brake shoe 2, 3. Each of the plates is provided with a notched groove 14a, 15a.

The bottom section of the notched groove 14a engages a cooperating notched groove 5b formed into the shoe web 5 of the second brake shoe 3. The bottom of the notched groove 15a engages with the bottom of the notched groove 5b formed into the shoe web 5 of the second brake shoe 3 and a cooperating notched groove 11c disposed on the end of the idler link 11 as seen in Figs. 1 and 3. In practice however, there will be a small gap at the bottom of the notched groove 11c of the long link 11. The gap results from the cumulative effect of the tolerances in fabricating the brake shoe 2, the link 11 and their mounting components.

The parking brake actuator means 16 is comprised of a forward-pull brake lever 17, the strut 18, and other components shown in Fig. 1 and Fig. 4. When the parking brake is applied by the vehicle driver, the brake lever 17 is pulled forward, i.e. moved in the clockwise direction as seen in Fig. 1. The brake lever 17 is disposed substantially parallel and overlapping with the shoe web 5 of the second brake shoe 3. Its base end 17a is pivotally mounted via a pin 19 at the lower end 3b of the second brake shoe 3. A remote control cable (not shown) is connected to a U-shaped groove at the free end 17b of the brake lever 17. A stopper 17c abuts against the inner face of the shoe rim 4 and regulates the return position of the brake lever 17 when the parking brake is not engaged. The brake lever 17 when applied, engages a strut

18 having notched grooves 18a, 18b provided on either end as shown in Fig. 4. The bottom of the notched groove 18a engages with the bottom of the notched groove 17d of the brake lever 17.

Similarly, the bottom of the notched groove 18b engages the bottom of the notched groove 11d provided on the end of the idler link 11 with a minimum gap. This gap arises due to tolerances in fabricating the brake lever 17, the strut 18 and their mounting components. The gap can be absorbed when assembling and adjusting the remote parking brake cable (not shown). As shown in Fig. 3, a tubular member 20 serves as an outer casing for guiding the remote control cable for attachment to the parking brake lever 17. The tubular member 20 is secured to the back plate 1 in this embodiment.

As shown in Fig. 1, an first return spring 21 is provided adjacent to the service brake actuator 8, which is stretched apart when the actuator 18 forces the brake shoes outwardly. The return spring 21 is attached to the first adjacent ends 2a, 3a of the brake shoes 2, 3. In this embodiment, a second return spring 22 is provided adjacent to the anchor block 9, which is tensioned between the second pair of adjacent ends 2b, 3b of the brake shops 2,3. The mounted loads of the return springs 21, 22 are set such that the second adjacent ends 2b, 3b of the brake shoes are held in engagement with the anchor block 9, i.e. do not spread apart. More particularly, the torque adjusted by arranging the force of the second return spring 22 and the distance from the pivot mount of the brake shoe with the link to the second return spring 22, is greater than the torque adjusted by arranging the force of the first return spring 21 and the distance from the pivot mount of the brake shoe with the link to the first return spring 21.

The desired return force can also be expressed using a further parameter of the brake drum system, namely the distance Ll and L2 of the first return spring 21 and the second return spring 22 from the pivot point 11a on the first brake shoe 2 as shown in Fig. 1. The return action of the springs is then expressed in terms of torque about the pivot point by the following relationship:

$$F1 \times L1 < F2 \times L2,$$

wherein,

F1: Mounted load of the first return spring 21;

F2: Mounted load of the second return spring 22;

Ll: Distance from the pivot point of brake shoe 2 with link 11 to the first return spring 21;

L2: Distance from the pivot point of brake shoe 2 with link 11 to the second return spring 22.

The operation of the brake device according to this embodiment will now be discussed. When the driver depresses the brake pedal (not shown), the service brake actuator 8 is pressurized forcing the first adjacent ends 2a, 3a of the brake shoes 2, 3 to spread apart. The second adjacent ends 2b, 3b of the brake shoes engage with the anchor block 9 as a fulcrum during this movement. The movement forces the lining 6 of the brake shoes against the interior surface of the rotating brake drum (not shown), whereby the created friction produces the braking force on the wheels of the vehicle. At this time, one of the brake shoes has a self-servo function, depending on the rotation direction, while the other does not. Hence, the brake device functions as a leading-trailing type.

Next the operation of the parking brake is explained in conjunction with the embodiment shown in Fig. 1. For example, when the hand brake lever is applied, the free end 17b of the brake lever 17 is caused to move to the right in Fig. 1 by means of the control cable (not shown). The brake lever 17 turns clockwise about the pivot pin 19 mounted to the end 17a. With the clockwise movement, the lever 17 engages the strut 18 and forces it to the right in the figure. The strut 18 engages the notched groove 11d of the idler link 11, which produces counter-clockwise movement of the link 11 about its protuberance 11a. The counter-clockwise movement of the link 11 transmits a force to the notched groove 5b of the second brake shoe 3 via the shoe clearance adjustment device 12. The transmitted force causes the first end 3a of the second brake shoe 3 to spread open, thereby pressing the lining 6 against the brake drum. The second end 3b of the second brake shoe 3 acts as a fulcrum, being engaged with the anchor block 9.

Moreover, when the hand brake lever is applied, the idler link 11 turns counter-clockwise direction about the notched groove 11c engaging the right end of the clearance adjustment device 12 as seen in Fig. 1.

The action transmits a force to the hole 5a in the first brake shoe 2 via the protuberance 11a.

As mentioned above, the torque F2 x L2 is larger than the torque F1 x L1.

Thus the force transmitted to the hole 5a causes the first brake shoe 2 to open at its upper first end 2a, while its second end 2b acts as the fulcrum, being engaged with the anchor block 9.

If at the time of applying the parking brake, a clockwise torque is acting on the brake drum, then the force applied to the second brake shoe 3 by means of friction is transferred to the first brake shoe 2 via the shoe clearance device

12. The second end 2b of the brake shoe 2 is then supported by the anchor block 9 to generate the parking force of the parking brake. Hence, the brake drum device functions as a duo-servo type in which both brake shoes 2, 3 have a self-servo function. If when the parking brake is applied, a torque is acting in the counter-clockwise direction on the brake drum, then the force applied to the first brake shoe 2 by means of friction is transferred to the second brake shoe 3 via the shoe clearance adjustment device 12. The second end 3b of the second brake shoe 3 is supported by the anchor block 9 to generate the braking force of the parking brake. Again, the drum brake device functions as a duo-servo type in which both brake shoos 2, 3 have a self-servo function.

In this manner, the upper portion of the first brake shoe 2 forces the lining 6 against the brake drum. As is apparent, the two brake shoes 2, 3 do not separate from the anchor block 9 until the brake drum rotates, when either the service brake or the parking brake is applied. The effect is the same when both brakes are applied simultaneously. Consequently, the second respective end 2b, 3b of the brake shoes 2, 3 do not collide with the anchor block 9 to generate noise. In addition, no substantial impact load arises against the anchor block.

Also, the adjacent ends 2b, 3b of the brake shoes 2, 3 are supported by the anchor block 9 thereby maintaining the stable operation regardless of a vehicle in motion, even when the brake lever 17 is set in a slightly pulled position by adjusting the control cable (not shown in the diagram) in a slightly pulled position.

As also shown in Fig. 1, automatic adjustment means are provided which include the adjustment lever 25 pivoted about a pin 24 and an adjustment spring 26 mounted to bias the adjustment lever 25.

The spring 26 is mounted at one end to the web 5 of the first brake shoe 2. As will be discussed below, when the service brake is applied and the first brake shoe 2 opens, this mechanism also serves to constrain the movement of the link 11 to be in tandem with the movement of the first brake shoe 2.

Turning to a second embodiment, Fig. 7 shows a modified drum brake device, where similar or the same components of Fig. 1 are identified with the same reference numerals. The return springs 21, 22 are replaced by a single wire spring 23 formed in the shape of a slightly obtuse U. The wire spring 23 is fairly thick compared to the wire used for the return springs 21, 22 (tensile coiled springs). A central portion of the wire spring 23 is secured to the anchor block 9, while the two free ends 23a engage with the two brake shoes 2, 3 respectively. The ends 23a are bent so as to firmly latch into holes 5c bored in both the brake shoes 2 and 3.

The holes 5c define the point of application of the return force applied by the U-shaped wire spring 23.

This point lies offset from the central region of the respective brake shoes in the direction toward the anchor plate 9. This point of application of return force is important for the braking action caused when the brake is applied. Namely, with this arrangement of the wire spring 23, the first ends 2a, 3a of the brake shoes 2, 3 will open when the parking brake is applied. As in the first embodiment, the second ends 2b, 3b of the brake shoes are urged to maintain contact with the anchor block 9.

In a further embodiment, the drum brake device of the present invention is provided with an automatic clearance adjustment function. This function can be employed in any of the embodiments discussed above, particularly the embodiment of Figs. 1 and 3. As shown in Fig. 8, an adjustment lever 25 is pivotally mounted to the idler link 11 by means of a pin 24. Furthermore, a stem component 24a extends through an elongate hole 5d bored in the shoe web 5 of the first brake shoe 2. The adjustment lever 25 lies above the shoe web 5 as seen in Fig. 1 and also has a hole 25a for pivotal engagement with the stem component 24a of the pin 24. As seen in Fig. 1, an arm 25b of the adjustment lever 25 abuts against the stepped face 15b of the notch groove 15a at the end of the clearance adjustment device 12 (Fig. 3). The other arm 25c of the adjustment lever 25 is disposed to engage with the toothed adjustment wheel 13a of the adjustment bolt 13. In an alternative arrangement, the pin 24 can be secured to the shoe web 5 instead of the idler link 11 whereby the adjustment lever still pivots about the stem component 24a. As also seen in Fig. 1, an adjustment spring 26 is mounted between a third arm 25d of the adjustment lever 25 and the shoe web 5. The spring 26 urges the adjustment lever 25 to rotate in the counter-clockwise direction as seen in Fig. 1 about the pin 24.

The operation of the automatic clearance adjustment will now be explained. When the service brake is applied and the two brake shoes 2, 3 open to the outside, the shoe clearance adjustment device 12 trails the second brake shoe 3. On the other hand, the idler link 11 would trail the first brake shoe 2. However the link 11 receives the force of the adjustment spring 26, which turns it clockwise as shown in Fig. 1 about the pivot member 11a. As a result the arm 25c of the adjustment lever 25 is turned counter-clockwise with the pin 24 as a fulcrum by an amount equal to the angle with respect to the pin 24 defined by the movement of the pin 24 and the clearance adjustment device 12.

As the linings 6 of the brake shoes 2, 3 become thinner due to wear, the degree of rotation of the arm 25c will exceed the inner tooth pitch of the toothed adjustment wheel 13a. When this occurs, the bolt 13 will be rotated by the arm 25c to be screwed out of the sleeve 14 as seen in Fig. 3. This mechanism automatically adjusts the gap between the brake drum and the linings 5 to maintain a substantially constant clearance.

When the parking brake is applied, the clearance adjustment device 12, one notched groove side of the idler link 11, the adjustment lever 25 and other components all trail in tandem with the second brake shoe 3 by the amount it is open.

However, the pin 24 is freely movable in the elliptic hole 5d of the first brake shoe 2, such that no effect on the

adjustment lever 25 results. The automatic adjustment action will not be less than the movement of the adjustment lever 25 when the service brake is applied. In this embodiment, the force of the adjustment spring 26 always acts to tension the idler link 11 such that its lower end face 11e remains abutted against the anchor block 9, even when the brake is released so that the link 11 will not vibrate. The advantage of the present automatic adjustment can also be realized in the embodiment with one return spring as indicated in Fig. 7.

In the above embodiment, the link 11 opens together with the first brake shoe 2 by means of the urging force of the spring 26. A modified configuration will now be discussed in conjunction with the embodiment of Figs. 9 and 10. Those components which differ from the above Embodiment 3 are marked with an apostrophe. In Embodiment 3, the lower end face 11e of the link 11 abuts against the anchor block as shown in Fig. 1. In the present embodiment shown in Fig. 10, the urging force of the adjustment spring 26 also keeps the brake outer side of the pin 24 abutted against the inner circumferential surface of the elongate hole 5d formed in the shoe web 5'of the first brake shoe 2. The braking operation and automatic adjustment action provided by this Embodiment 4 are the same as in the above Embodiment 3 and an explanation is omitted.

As shown in Fig. 11, the same function of controlling movement of the link 11 can be obtained by providing a second protuberance 11'f at the second end of the link 11' which abuts against the brake inner side of the large diameter hole 5'e formed in the shoe web 5'. Alternatively, a projection 11'g can be provided on the long link II', the projection engageable with an inner surface of the shoe rim 4'. Important for the invention is that when the service brake is applied, the link 11' spreads open together with the first brake shoe 2' and that when the parking brake is applied, the link 11' and the first brake shoe 2' turn relative to one another. As will be apparent from the above modifications, even when the brake lining wears with time, the link 11', adjustment lever 25 and adjustment spring 26 move substantially in unison with the first brake shoe 2. In addition, no adverse effects occur on the automatic adjustment action and a stable reliable adjustment is possible over a prolonged period of time. A further embodiment relating to a modified adjustment mechanism is shown in Fig. 11. As with the above embodiment, this embodiment provides common movement of the link 11' and the brake shoe 2' by means of the mechanism II'f and 5'e.In contrast to Embodiment 3, the present arrangement provides the adjustment lever 25' on the second brake shoe 3'. In effect, this arrangement is mirror symmetrical to that of Fig. 9 with respect to the automatic adjustment mechanism. The pivot pin 24' is formed on the shoe web 5' of the second brake shoe 3'. The adjustment lever 25' is constantly urged in the clockwise direction by the adjustment spring 261'. The action of automatic adjustment in this embodiment is the same as in Embodiment 3 and will not be repeated here. The engaging position of the adjustment lever 25' with the adjustment wheel 13a does not change even if the brake lever 17 is set with only a slight pull or stroke. No impairment of the adjustment function therefore arises.

A further embodiment of the present drum brake device will now be discussed in conjunction with Figs. 12 to 14. The same components having the same function as in the previous embodiments are identified with like reference numerals in the 100-series. This embodiment is equipped with a one-shot type automatic clearance adjustment device and a cross-pull type mechanism for the parking brake. As seen in Fig. 12, the brake device comprises a back plate 101, two brake shoes 102, 103 with a first pair of adjacent ends 102a, 103a and a second pair of adjacent ends 102b, 103b.

Further included are an actuator 108, an anchor block 109, an idler link 111 with a pivot member 111a, a notched groove 111c, 111d at either end of the link 111 and a lower end face 111e of the link 111, an first return spring 121 and a second return spring 122. The return force of the second return spring 122 in its mounted state is such that when the parking brake is applied, the second ends 102b, 103b of the brake shoes do not pull away from the anchor plate 109. As with the first embodiment of Fig. 1, the mounted load of the second return spring 122 is selected such that when the parking brake is applied, the second ends 102b, 103b of the brake shoes 102, 103 do not spread open.

The clearance adjustment device 112, best seen in Fig. 13, comprises a plate portion 113, a bell crank lever 114, as well as two spring members 126, 127. The bottom of the notched groove 113a formed at one end of the plate member 113 engages with the bottom of the notched groove 111c at the end of the idler link 111 as seen in Fig. 13. A toothed portion 113b is formed at a central section of the plate member 113.

The middle segment of the bell crank lever 114 is supported by the stem of a pin 115 so as to pivot on the other end 113c of the strut 113 and to move lengthwise along the plate face of the strut 113 as shown in Fig. 13. A fan-shaped arm 114a of the bell crank lever 114 has a toothed portion 114b formed in its outer perimeter, which meshes with the toothed portion 113b of the plate member 113. Another arm 114c of the crank lever 114 is provided with a cam surface having a clearance δ 1 within a rectangular hole 103 formed in the second brake shoe 103 as shown in Fig. 13.

The adjustment spring 126 is disposed between the first brake shoe 102 and the plate member 113, while the second spring 127 is disposed between the plate member 113 and the pin 115.

Referring to Fig. 14, a cross-pull actuator 116, activated by the parking brake, comprises the brake lever 117 and the strut 118. A finger-shaped portion 117a of the brake lever 117 engages against the bottom of the notched groove 103d formed on the second end of the second brake shoe 103. The arm 117b on the other end of the brake lever 117 penetrates freely through a hole 101d formed in the back plate 101. A mounting hole 117c is provided for connecting the remote control cable (not shown), the hole being bored on an end of the arm 117b. A stop 117d is also formed on

the brake lever 117, which abuts against the reverse side of the back plate 101 to regulate the return stop position of the lever.

The strut 118 has a notched groove 118a as shown in Fig. 14, in which the second end of the second brake shoe 103 passes. The brake lever 117 is also pivotable about a pin 119 as shown in Fig. 14. Another notch groove 118b of the strut 118, includes the notch groove 111d at one end of the idler link 111 and one brake shoe 102.

The operation of this embodiment will now be explained. The main difference from the embodiment of Fig. 1 is the brake lever 117 is now of the cross-pull type. When the brake lever 117 is pulled by the remote control cable, the brake lever 117 is urged against the strut 118 by means of the pin 119, which is pivotally mounted to the strut. The generated force is transmitted in sequence to the idler link 111, the clearance adjustment device 112 and finally to the rectangular hole 103 of the second brake shoe 103 as seen in Fig. 12. The first end 103a of the second brake shoe 103 opens, while the other second end 103b rests against the anchor block 109. The movement causes engagement of the lining of the second brake shoe with the brake drum.

At the same time, the generated force applied to the idler link 111 urges the first brake shoe 102 outwardly due to the engagement of the link 111 with the plate member 113. This causes the first end 102a of the first brake shoe 102 to move outwardly, whereby the second end 102b is engaged with the anchor block 9.

From the above it is apparent that the movement of the two brake shoes 102 and 103 is the same as that for the previous embodiment, whereby the same technical effect is achieved.

Again referring to Fig. 12, when the service brake is applied, the two brake shoes 102, 103 are urged outwardly. The clearance adjustment device 112 experiences the greater return force of the adjustment spring 126 and therefore follows the first brake shoe 102. As the linings 6 become worn down, the amount by which the shoes have opened eventually exceeds a value represented by the sum of the clearance δ 1 of the bell crank lever 114 (Fig. 13) and the height of the toothed portion 114b. The bell crank lever 114 then turns in the counter clockwise direction with the pin 115 as a fulcrum as shown in Fig. 13 by an amount equivalent to one tooth pitch on the toothed portions 113b and 114b. In this manner, the clearance for the brake shoes is set automatically.

When the parking brake is applied, the plate member 113 and the bell crank lever 114 move together with the second brake shoe 103 to the left as seen in Fig. 12. The adjustment spring 126 extends to move the first brake shoe 102 to the right, whereby there is no effect on the automatic adjustment mechanism.

The present invention has been explained by the above description of embodiments, however is not limited thereto. For example, an incremental type automatic clearance adjustment device as shown in Fig. 1 can be combined with the cross-pull type parking brake. In addition, the one-shot type as discussed in conjunction with Fig. 12 can be combined with a forward-pull type of parking brake shown in Fig. 1. Other modifications include superimposing the idler link 11, 11', 111 on that side of the shoe web 5 on which the brake drum is mounted.

Claims

1. A drum brake device comprising:

    first and second brake shoes (2, 3) disposed opposite one another on a back plate (1),

    a service brake actuator (8) disposed between a first pair of adjacent ends (2a, 3a) of said brake shoes (2, 3),

    an anchor block (9) disposed between a second pair of adjacent ends (2b, 3b) of said brake shoes (2, 3),

    a shoe clearance adjustment device (12) arranged adjacent to said service brake actuator (8) and disposed between said brake shoes (2, 3) parking brake actuator means (16, 18) disposed adjacent to said anchor block (9),

    an idler link (11) pivotally mounted at a central region of said first brake shoe (2),

    the first end (11c) and the second end (11d) of said link (11) functionally engaging with said shoe clearance adjustment device (12) and said parking brake actuator means (16, 18) respectively,
    wherein an adjustment mechanism (24, 25, 26) is provided to move the link (11) together with said first brake shoe (2) when the service brake actuator (8) is operated.

2. The drum brake device of Claim 1, wherein the second end (11e) of said link (11) is urged to engage with said anchor block (9).

3. The drum brake device of Claim 1, wherein a torque with the pivot component of the long link as the fulcrum is

imparted to said link (11) in the same direction of said first brake shoe spreading open with said anchor block as the fulcrum and said mechanism (24, 25, 26) to regulate the rotation is arranged between the link (11) and said first brake shoe (2).

4. The brake device of any one of the Claims 1 to 3, wherein said shoe clearance adjustment device (12) is adapted to sense the amount by which the said brake shoes (2, 3) have opened and automatically adjust the clearance between the brake shoes (2, 3) and the brake drum.

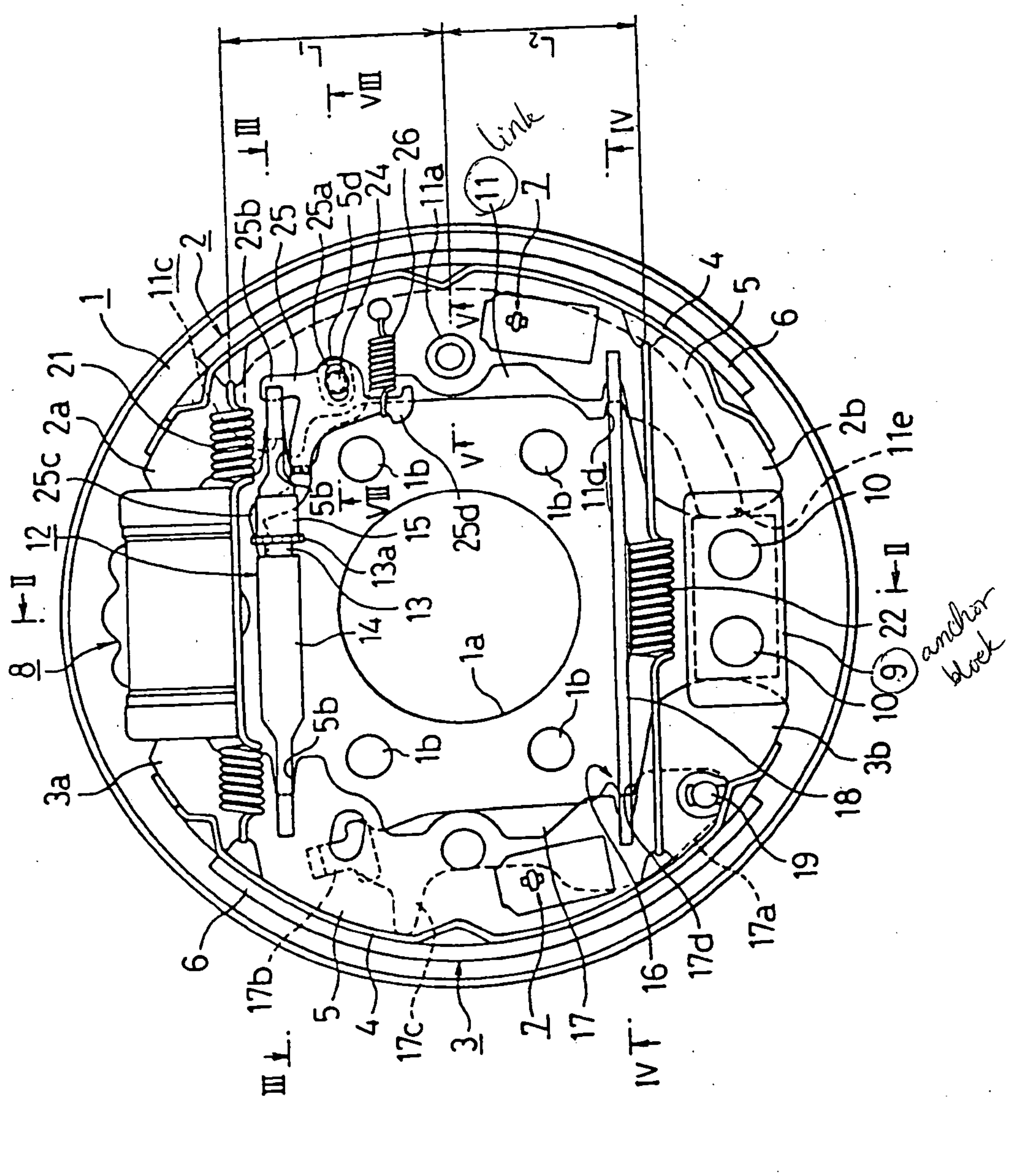
5. The drum brake device of any one of the Claims 1 to 4, wherein first and second shoe return springs (21, 22) or a single shoe return spring (23) is provided to urge the brake shoes (2, 3) toward one another and the force urging said second adjacent ends (2b, 3b) of said brake shoes (2, 3) toward one another is greater than the force urging said first adjacent ends (2a, 3a) of the brake shoes (2, 3) toward one another.

6. The brake device of Claim 5, wherein the amount of the torque applied to said second adjacent ends (2b, 3b) of said brake shoes (2, 3) which is adjusted by arranging the force of said second shoe return spring (22) and the distance from said pivotal mount (11a) of said brake shoe (2, 3) to said second return spring (22) is greater than the torque applied to said first adjacent ends (2a, 3a) of said brake shoes (2, 3) which is adjusted by arranging the force of said first shoe return spring (21) and the distance from said pivotal mount (11a) of said brake shoe (2, 3) to said first return spring (21).

7. The drum brake device of any one of the Claims 1 to 6, in which said shoe clearance adjustment device senses an amount by which said pair of brake shoes has opened and automatically adjusts the clearance between the brake shoes and a brake drum.

8. The drum brake device of any one of the Claims 1 to 7, wherein a protuberance (11b) is integrally formed by a press onto the central region of said idler link (11) and said protuberance (11b) is pivotable in a hole (5a) bored in said first brake shoe (2).

Fig. 1



8
12
25c
2a
21
1
11c
2
25b
25
25a
5d
24
26
11a
11
link
7
4
5
6
2b
11e
10
22
9
anchor block
10
3b
18
19
17a
17d
16
17
7
3
17c
4
5
17b
6
3a
5b
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13
13a
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25d
1a
1b
11d
II
III
IV
V
VI
VIII

Fig. 2

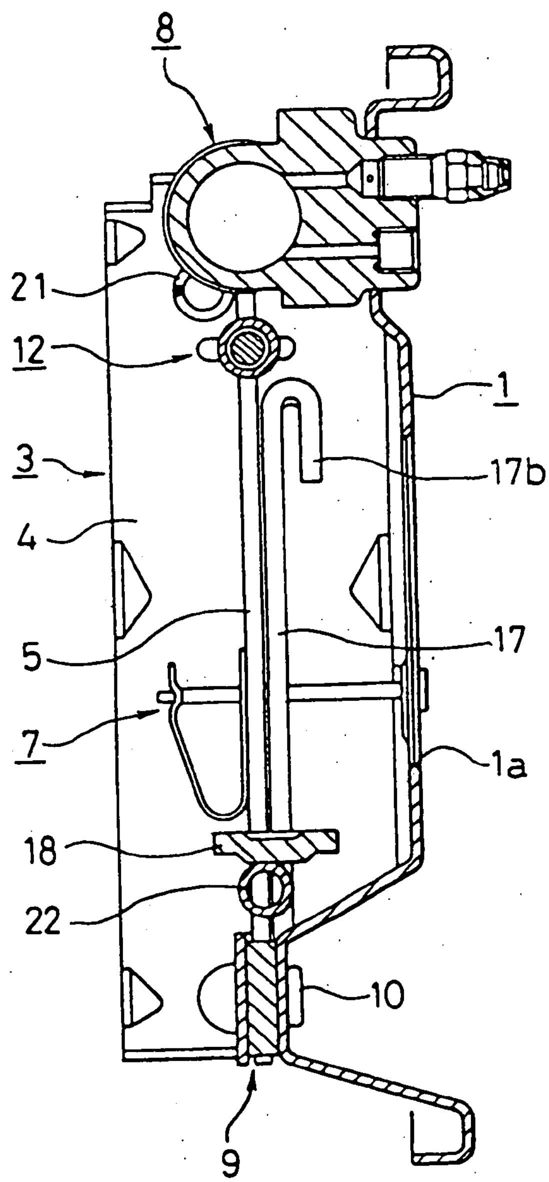


Fig. 3

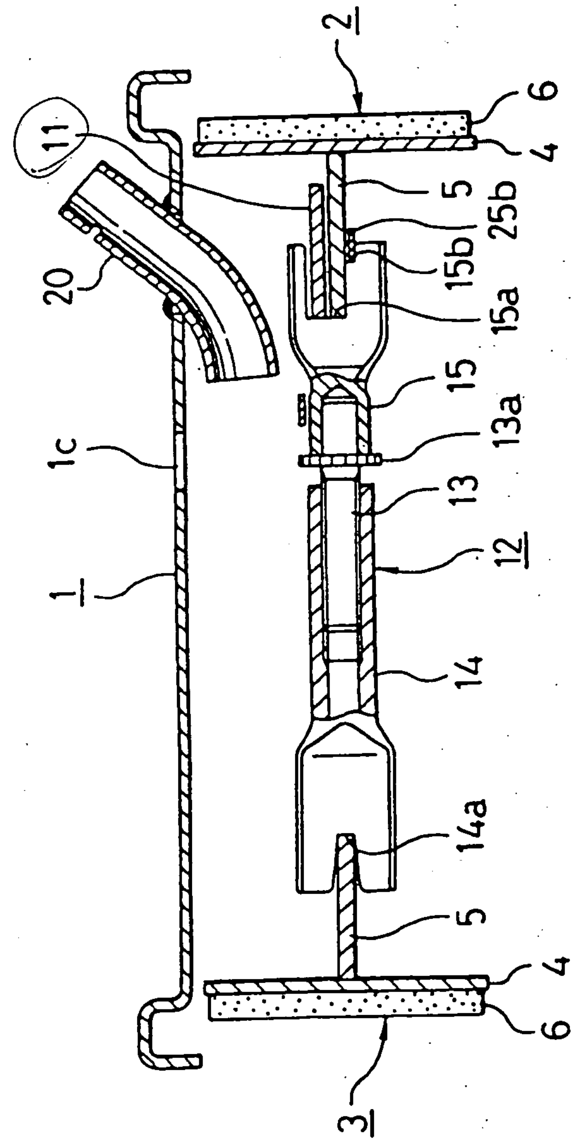


Fig. 4

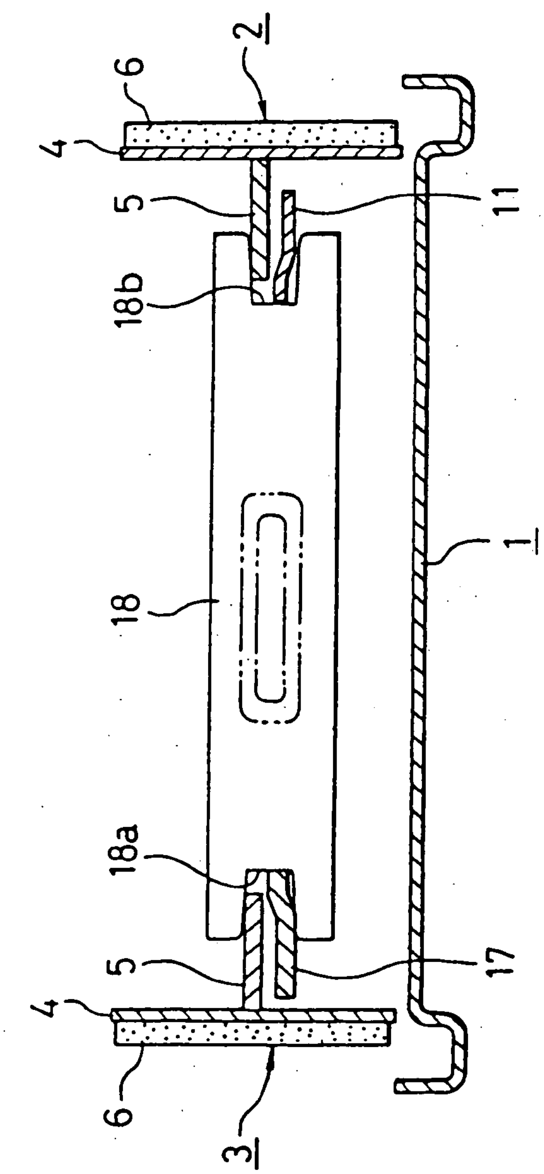


Fig. 5

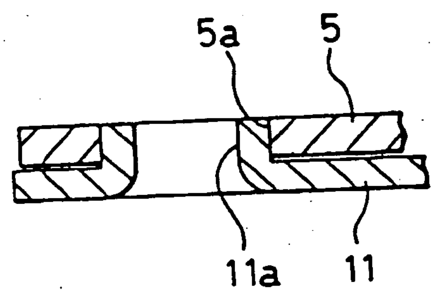


Fig. 6

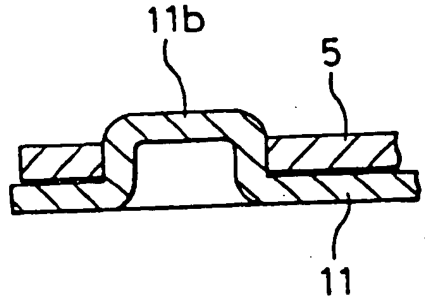


Fig. 7

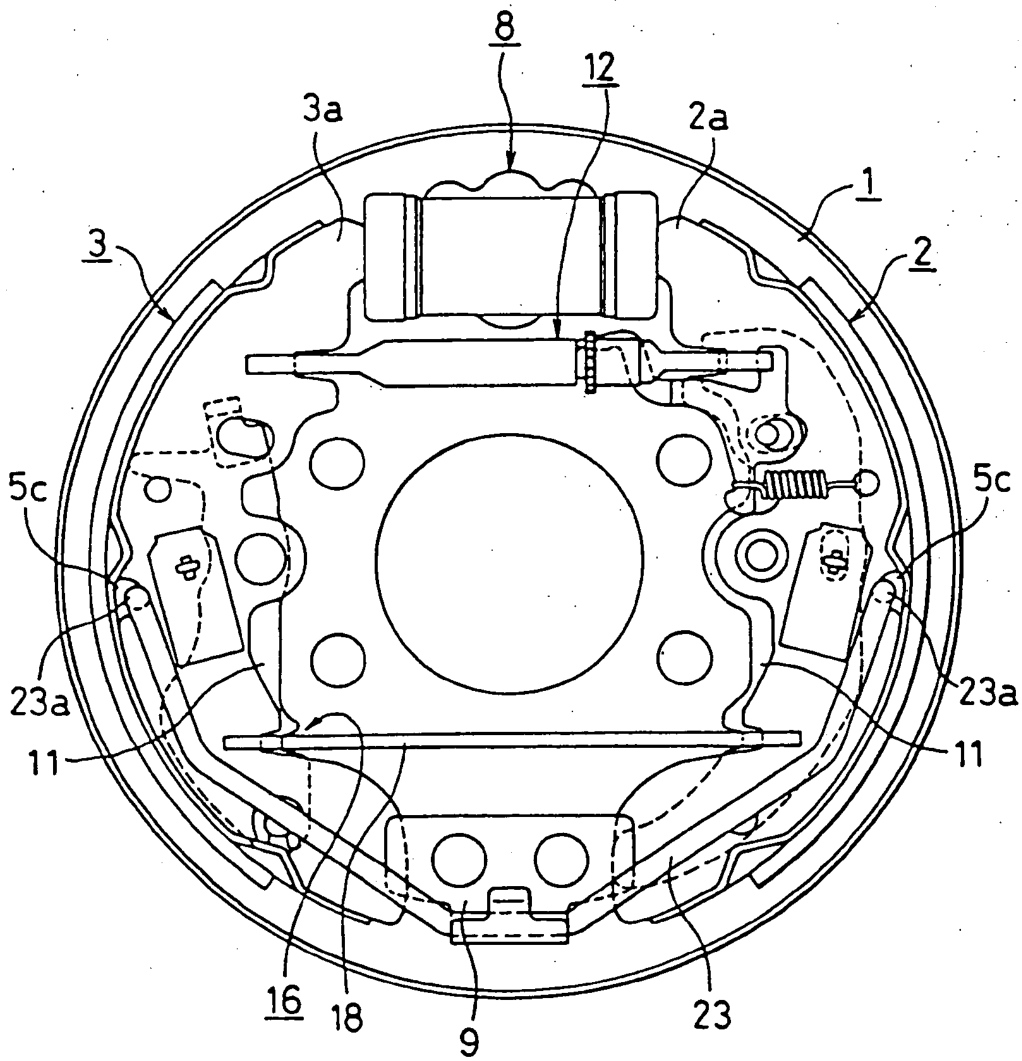


Fig. 8

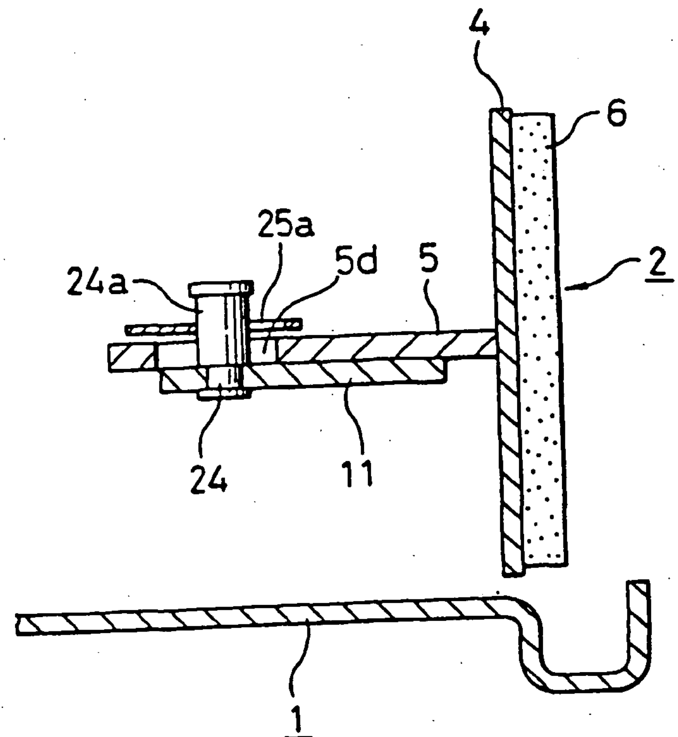


Fig. 9

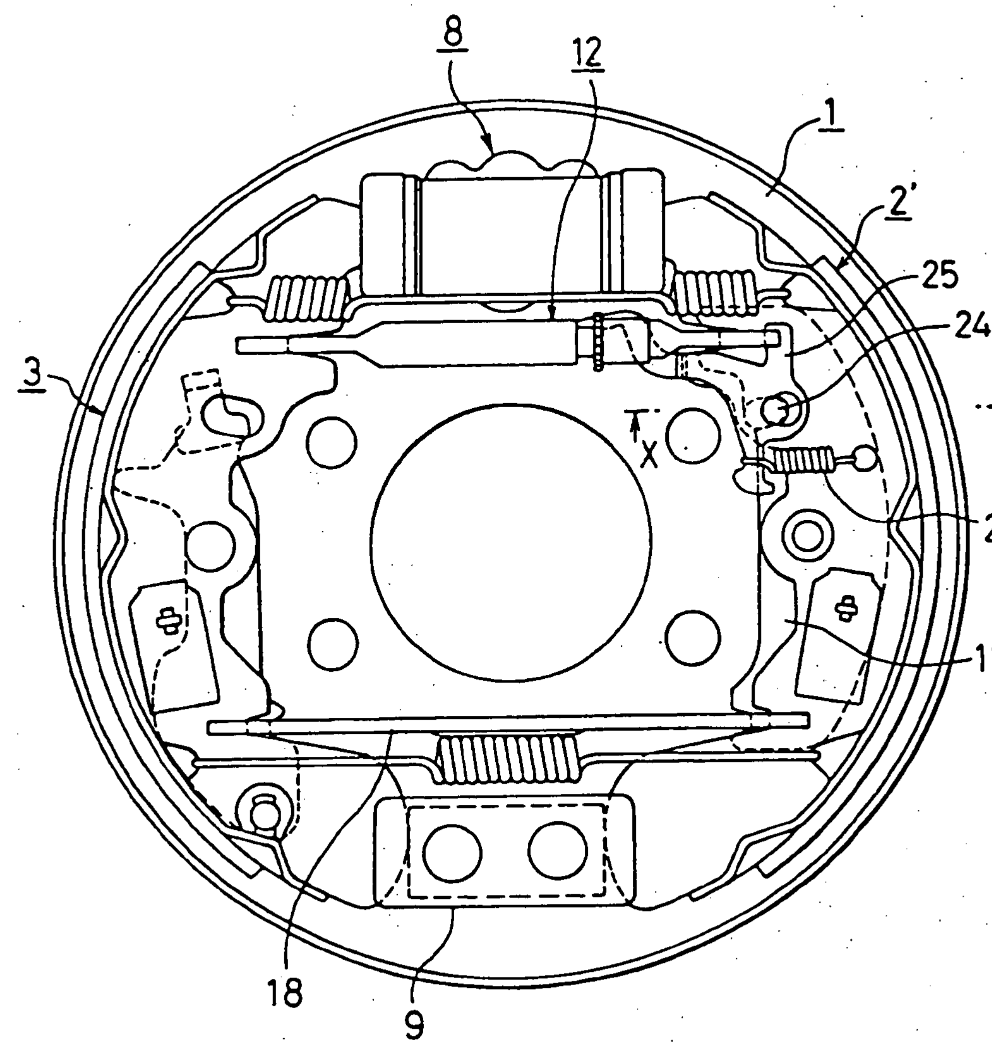


Fig. 10

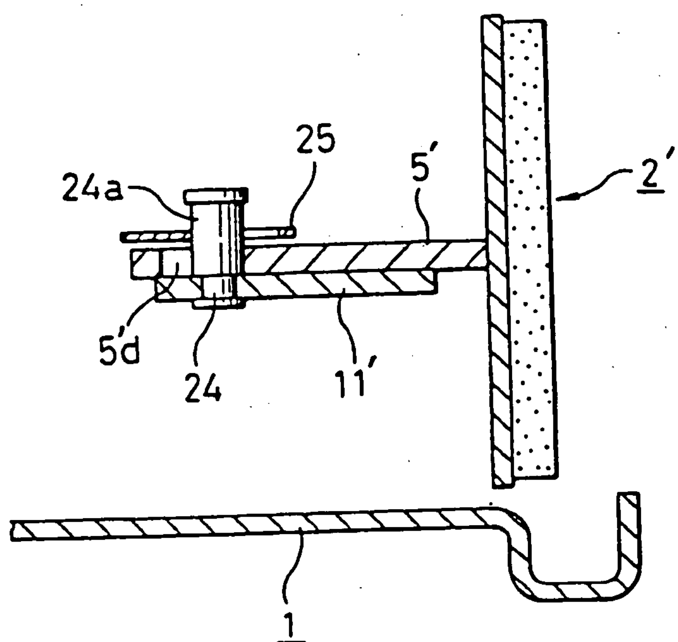


Fig. 11

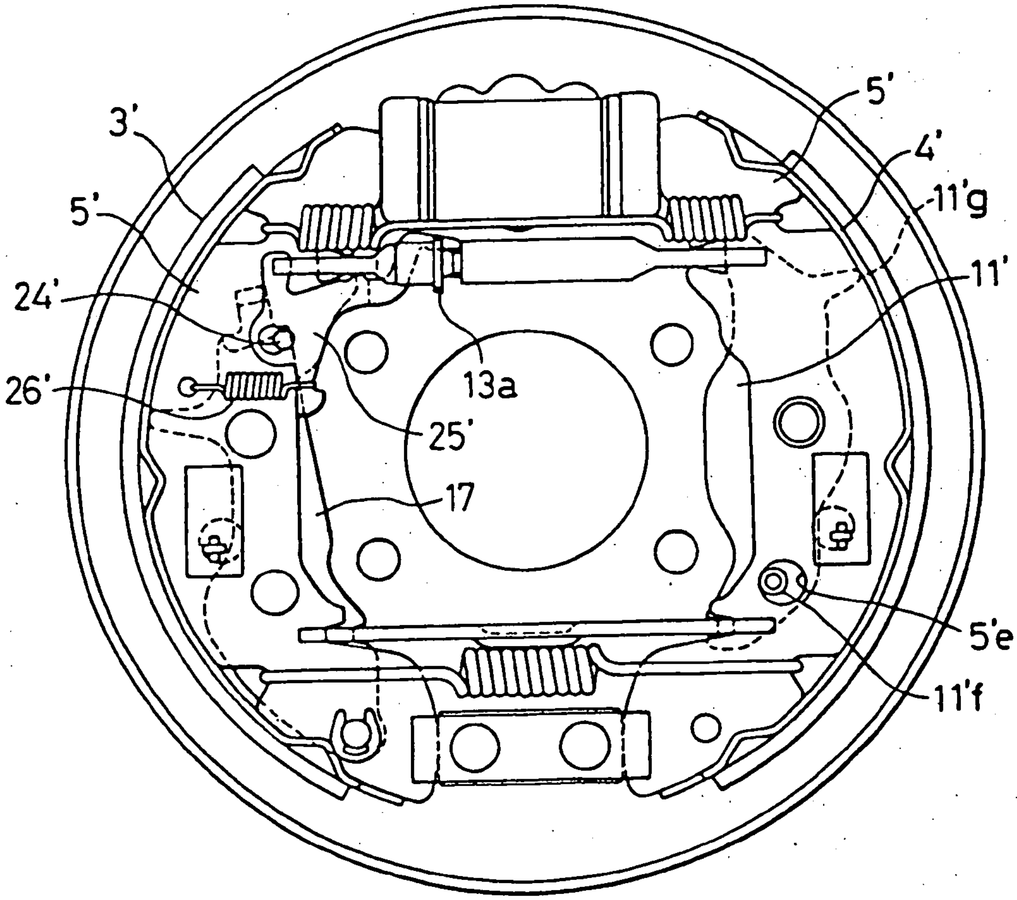
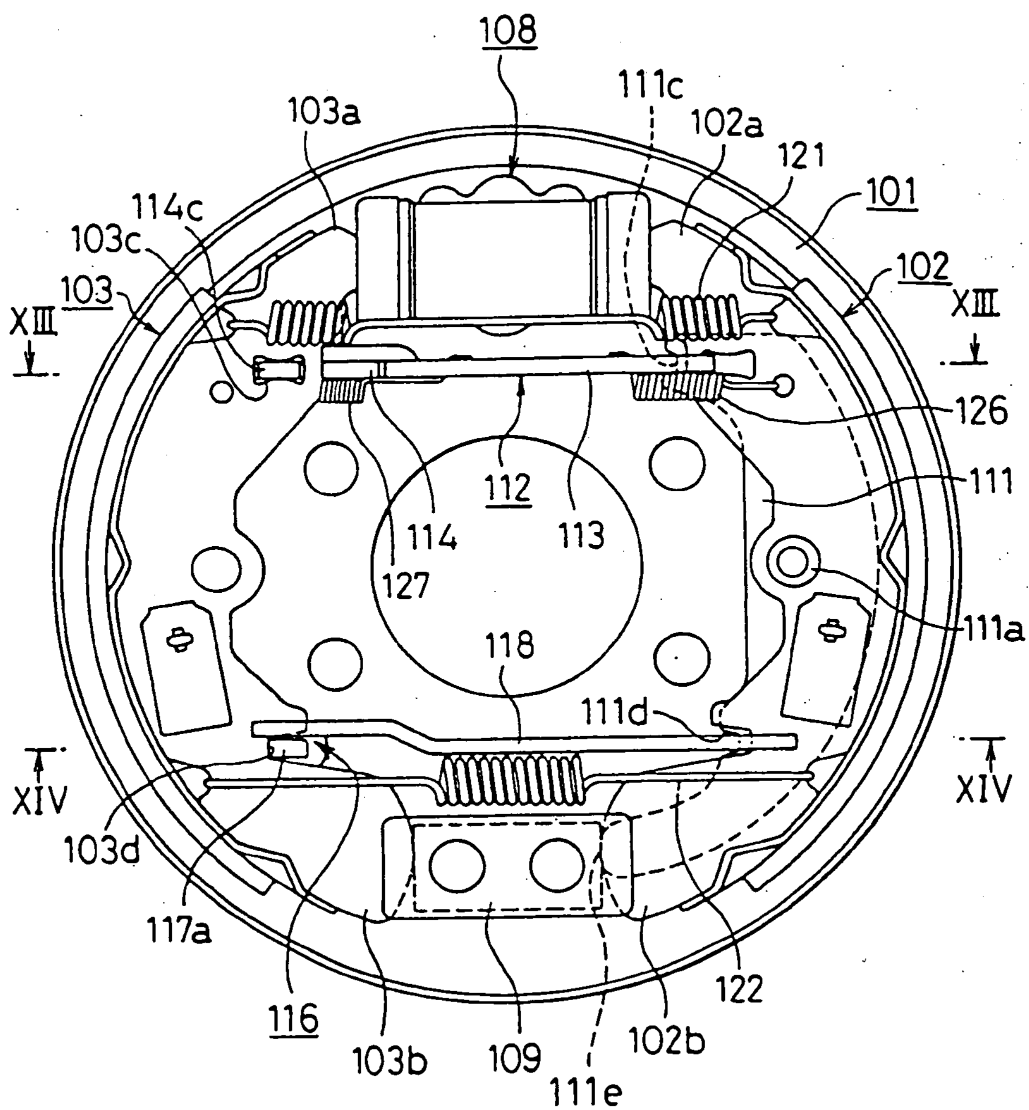


Fig. 12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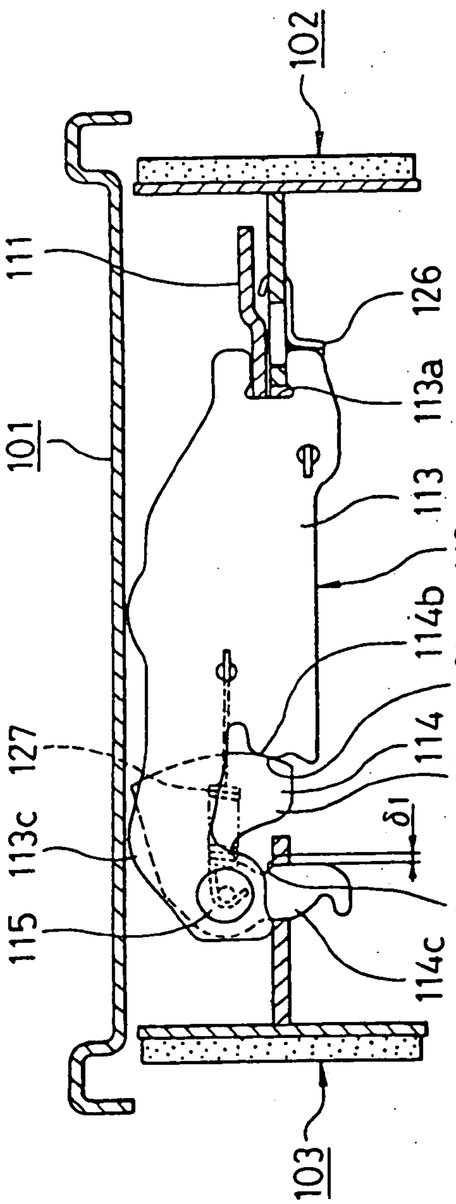
111d
XIV
XIV
103d
117a
122
116
103b
109
102b
111e

Fig. 13


101
102
103
111
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113a
113
112
114b
113b
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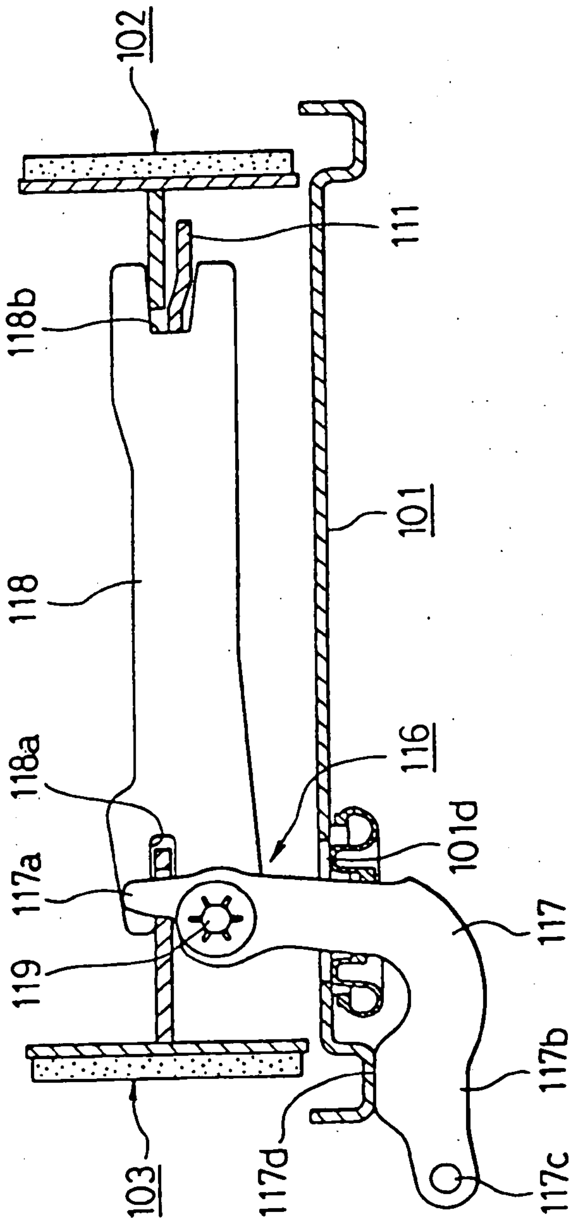
114a
127
113c
δ1
103c
115
114c

Fig. 14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101
118
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118a
101d
117a
117
119
117b
103
117d
117c

Fig. 15

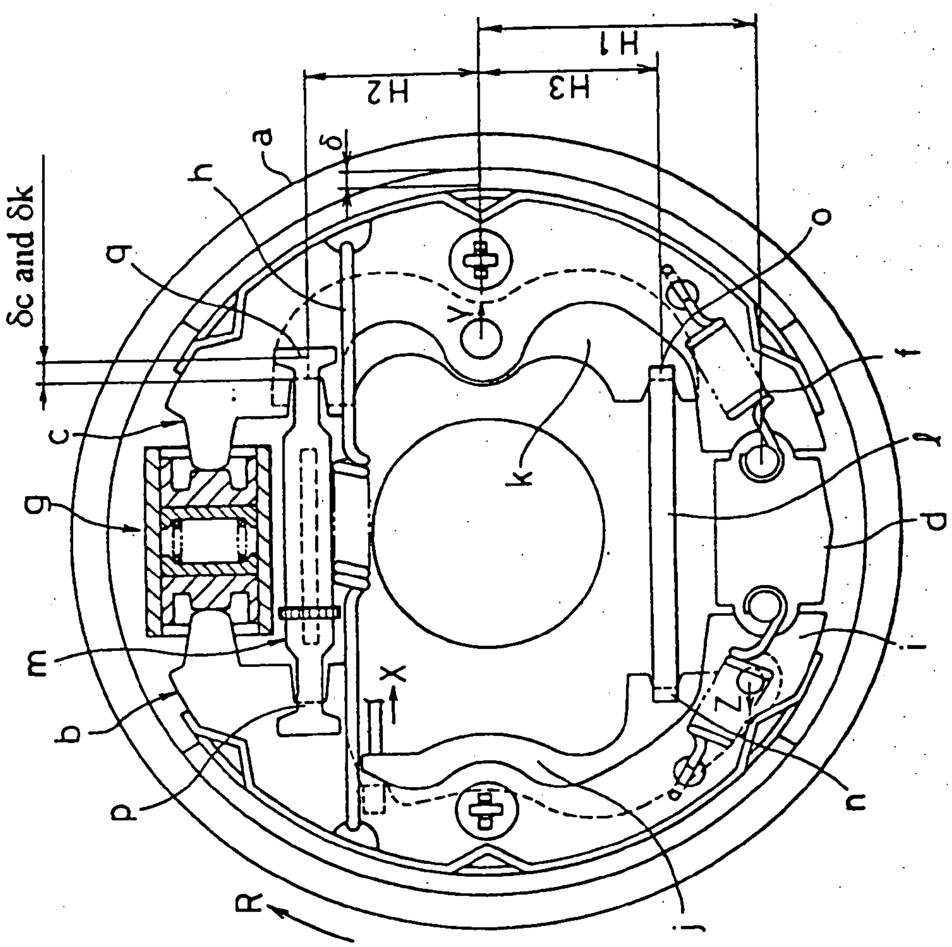
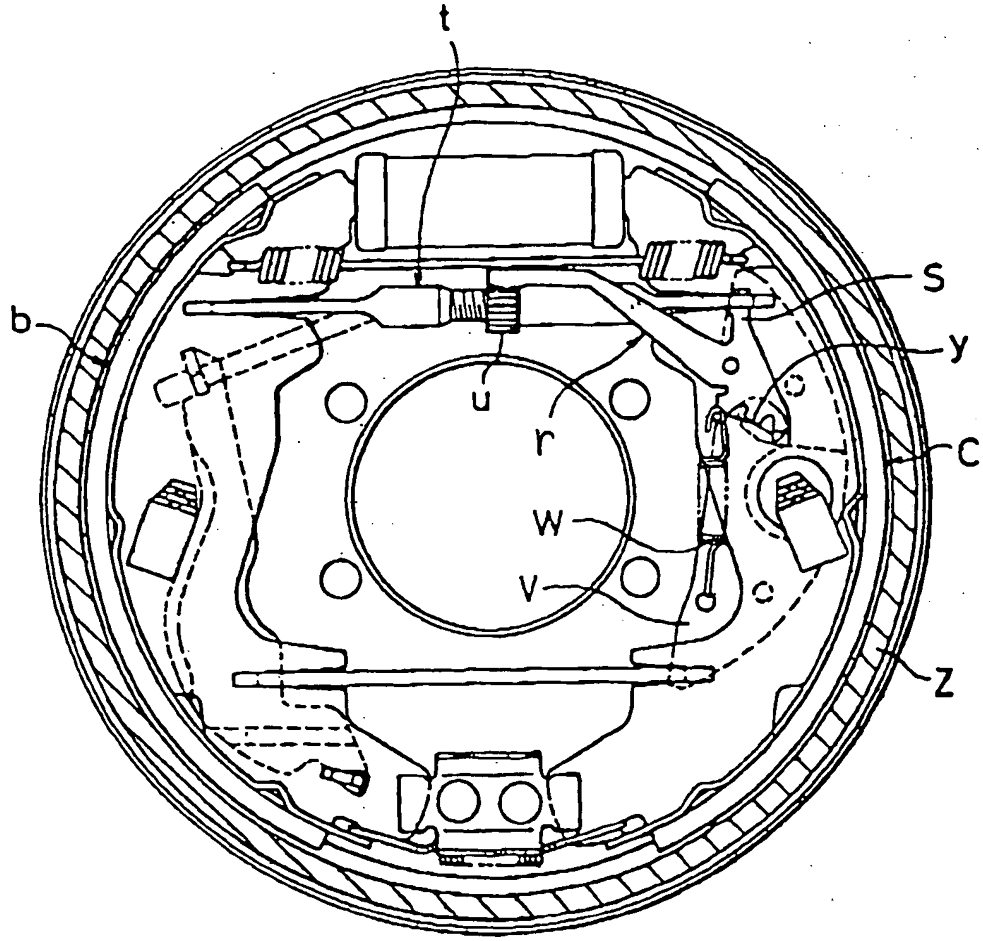


Fig. 16



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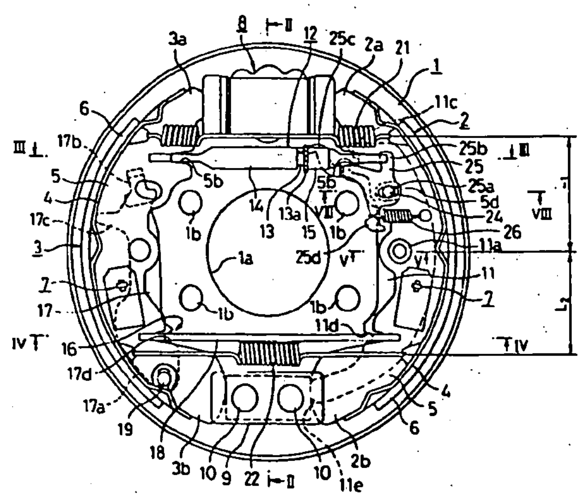
(54) **Drum brake device**

(57) A drum brake device is provided comprising a first and second brake shoes (2,3) disposed on a back plate (1). One set of adjacent ends (2a,3a) of the brake shoes engage a brake actuator (8). The other adjacent ends (2b,3b) engage a fixed anchor block (9). An idler link (11) is pivotally mounted on one of the brake shoes (2,3), which engages at one end with a shoe clearance adjustment device (12) and at its other end with a parking brake actuator (18). The idler link (11) moves in tandem with the first brake shoe (2) when the service brake is applied.

Fig. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 97 11 7416

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	FR 2 697 600 A (BENDIX EUROP SERVICES TECH) 6 May 1994 * page 4, line 15 - page 5, line 8; figures 1-4 *	1,3-84	F16D51/24 F16D65/56 F16D51/56 F16D65/58
X	US 4 364 456 A (COLPAERT JAMES J) 21 December 1982 * column 3, line 59 - line 68; figure 1 *	1,3-8	
X A	US 4 387 792 A (IMAMURA NORIAKI) 14 June 1983 * the whole document *	1,3,4,7,8 6	
X	US 5 360 086 A (CHARMAT DJAMEL) 1 November 1994 * the whole document *	1,3,4,7,8	
X A	US 3 575 266 A (SITCHIN AMNON) 20 April 1971 * abstract; figure 1 *	1 3,5,6	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	GB 2 194 300 A (AUTOMOTIVE PRODUCTS PLC) 2 March 1988 * abstract; figure 2 *	1,7	F16D
E	EP 0 800 014 A (NISSHIN SPINNING) 8 October 1997 * the whole document *	1,3-8	
L	EP 0 836 027 A (NISSHIN SPINNING) 15 April 1998 * the whole document *		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	17 November 1998	Curzi, D

CATEGORY OF CITED DOCUMENTS

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